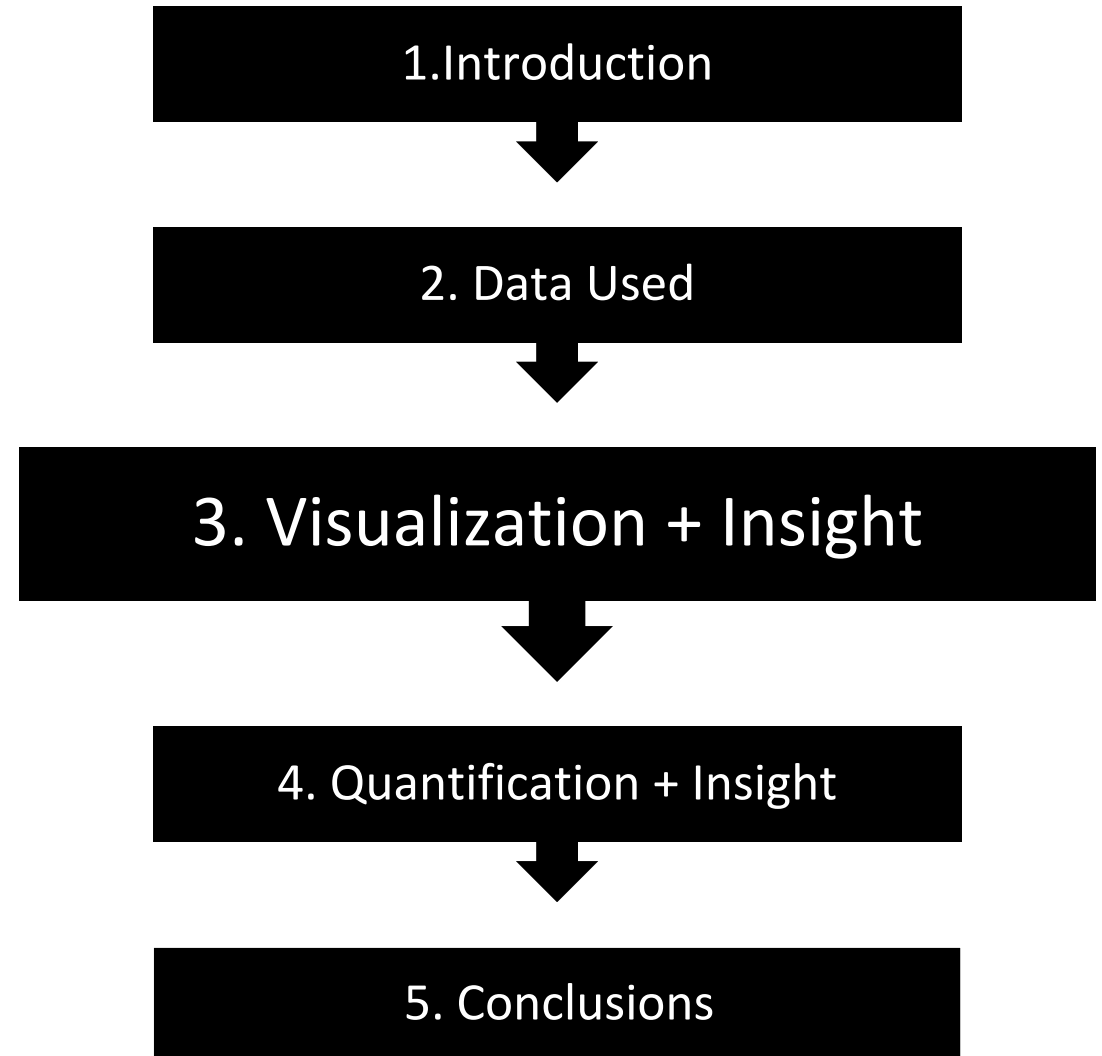


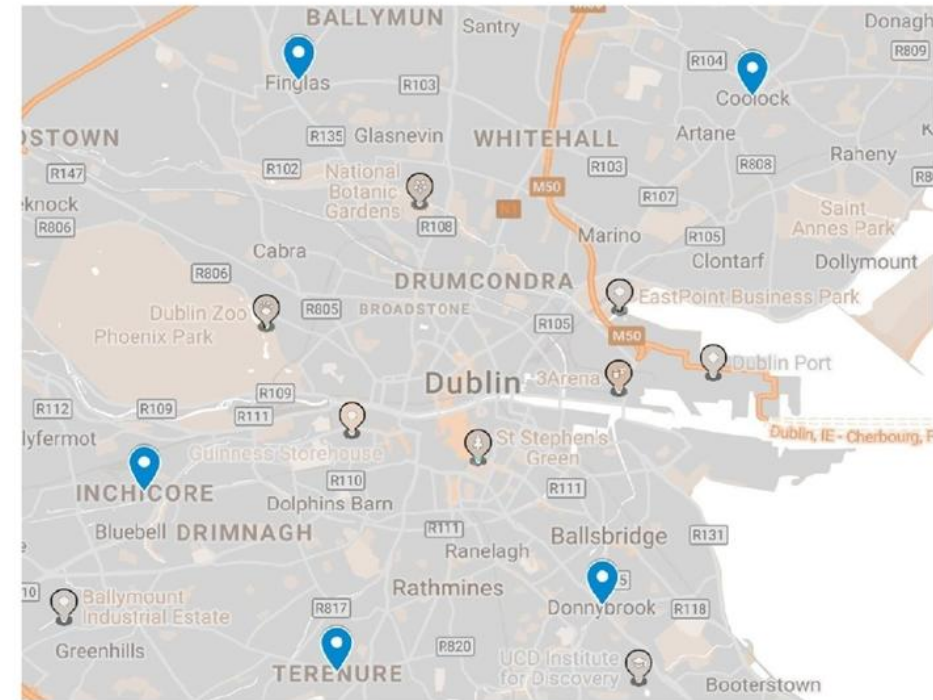
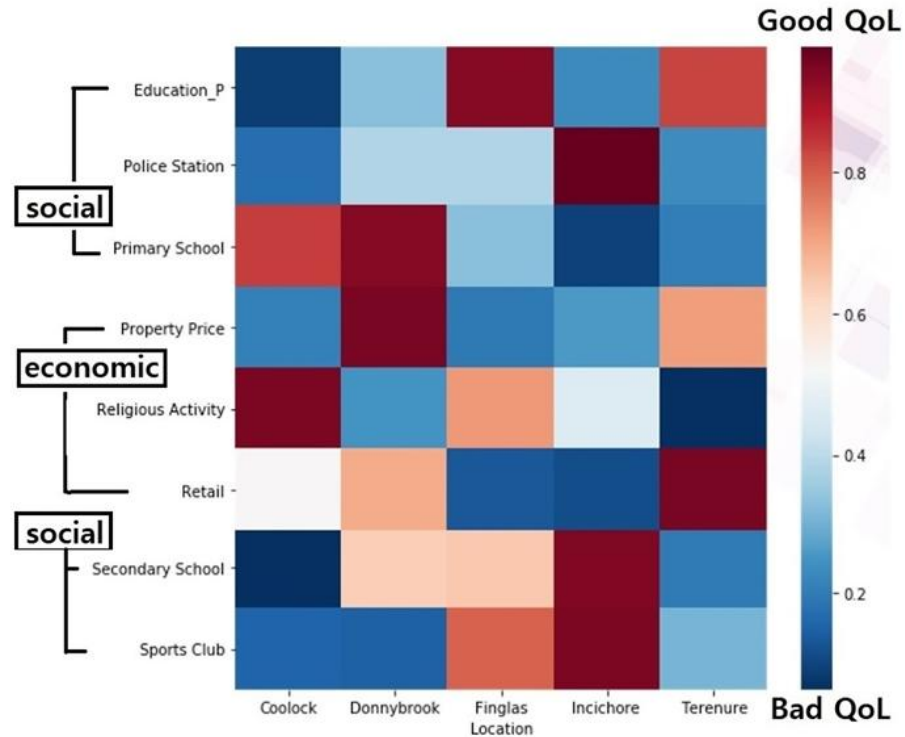
Dublin Quality of Life Study Version 2.0 (walkability in Dublin City)

- Minkun Kim
- Student ID: 18212693
- Email: minkun.kim4@mail.dcu.ie

Outline



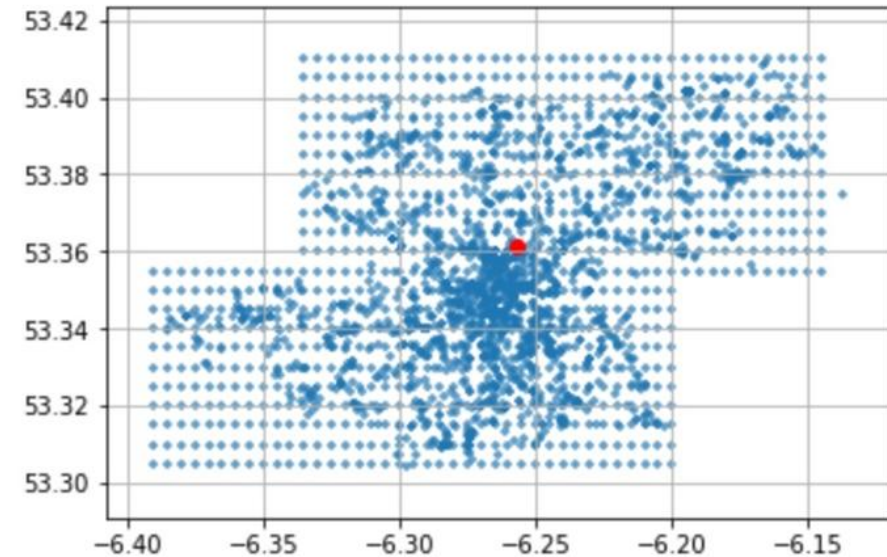
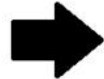
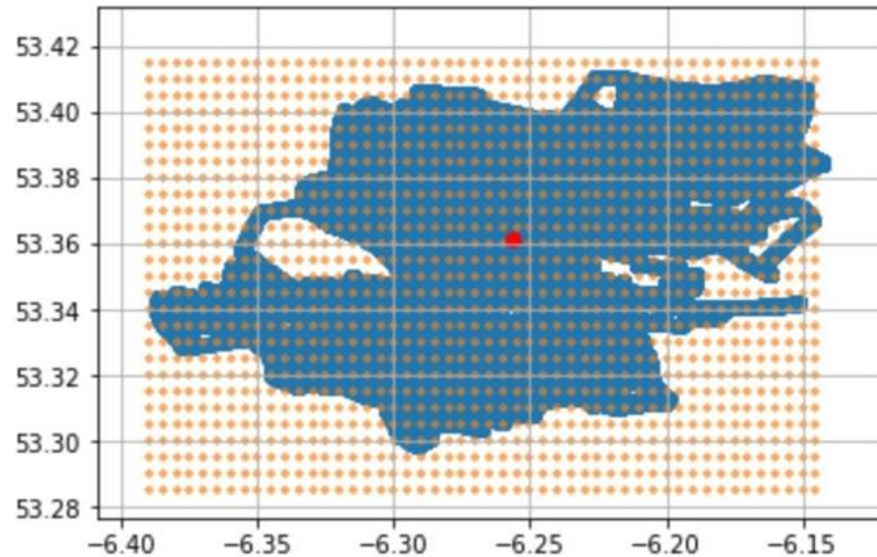
1. Introduction



Quality of Life Scoring Matrix was produced by the Insight team. It compared the Quality of Life in the five random areas in Dublin - Coolock, Donnybrook, Finglas, Inchicore, Terenure.

> QoL indicator → proximity to some amenities (+) property price, **but hard to understand..**

[Aim]: Bring it to a larger scale !



: Input

- > **1,000** random destinations (not 5) + **1,900** amenities (not 40) + Importance Weights + Real Estate Values
- > QoL indicator – walkability to amenities, importance weight, property price ... **Any relationship?**

: Output ?

4 Visualizations

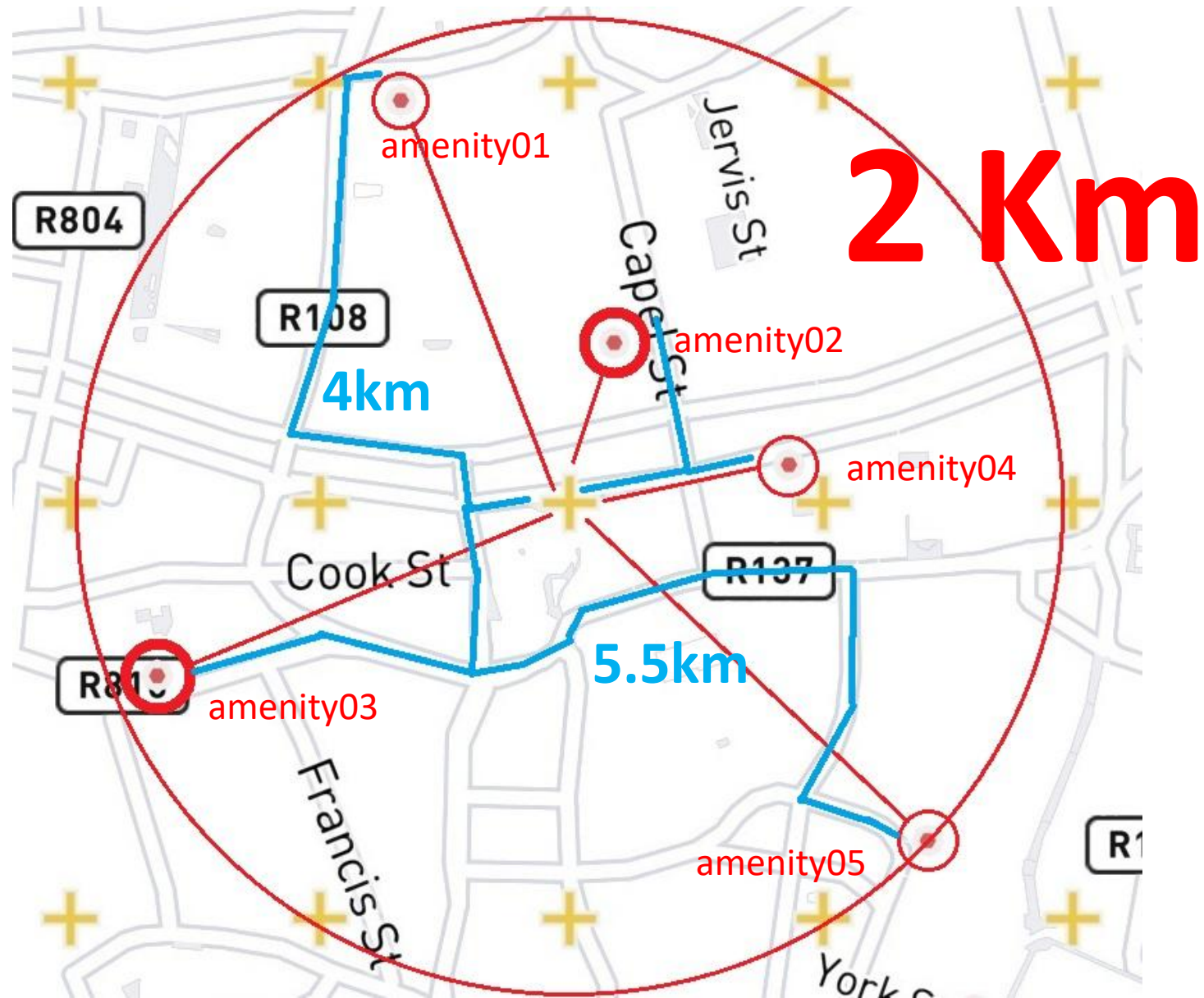
+

Extra Quantification

Why **Walkability** to understand QoL ?

[Proximity Analysis]:
= **Euclidean Distance**

[Walkability Analysis]:
= **Google Map API**



5 concepts to compute walkability

- Origins (40 → 1900 amenities)
- Destinations (5 → 1000 random)
- Euclidean Distance

New

- Footpath Distance
- Calculation within 2 Km radius



Footpath – Euclidean = ?

Q. Walkable ?

Facility Importance

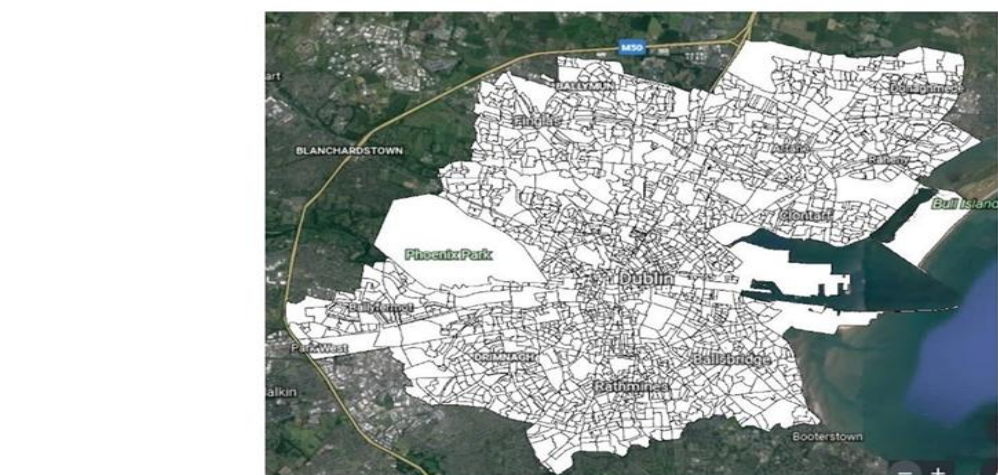
Q. More people?

House Price

Q. Rental Income?

Chain of thought

Baseline Method: Google Map Walkability Analysis



2. Data Used

```
<tr><td>Area</td><td>0</td></tr>
<tr><td>ChangeCode</td><td>0</td></tr>
<tr><td>Esri_oid</td><td>3882</td></tr>
<tr><td>Shape_are</td><td>0.000939067329705</td></tr>
<tr><td>Shape_len</td><td>0.149578267620919</td></tr>
<tr><td>Agglomname</td><td>Dublin</td></tr>
<tr><td>Population</td><td>462</td></tr>
<tr><td>Size_Km2</td><td>907.8</td></tr>
<tr><td>Lau2codes</td><td>0</td></tr>
<tr><td>Occupied_Dwell</td><td>91</td></tr>
<tr><td>Tmp_Absent_Dwell</td><td>2</td></tr>
<tr><td>Ave_Sap_Pop</td><td>0</td></tr>
]]></description><visibility>1</visibility><open>0</open><Style><LineStyle><color>FF000000</color><width> 1</width></LineStyle><PolyStyle><fill>1</fill><out1>
-6.351204999971,53.366512000035,0
-6.351215000054,53.366494999981,0
-6.351239999986,53.366459999965,0
-6.351262999956,53.366435999966,0
-6.351473000045,53.366082000015,0
-6.351582000012,53.365903000004,0
-6.351665000067,53.365767999991,0
-6.35171299997,53.365692999975,0
-6.351818000014,53.365520999982,0
-6.351933000004,53.365333999971,0
-6.352042999952,53.365152999996,0
-6.352168000025,53.364946999967,0
-6.352234999975,53.364841000007,0
-6.35231900001,53.364702999977,0
-6.352472999938,53.364446000004,0
-6.352781000068,53.363947999987,0
-6.353184000023,53.363292000011,0
-6.353364999982,53.362997000004,0
```

- : **KML** dataset loaded into Google Earth. The figure illustrates the **coordinate points** of the all areas accessible for this project (provided by Dublin City Council).
- : **NACE Codes** dataset groups organisations according to their **business activities** and provides relevant information with consistent items (provided by Dublin City Council)

* **NACE Codes** dataset.

- Size 1. Primary schools: 216
- Size 2. Secondary schools: 65
- Size 3. University/Institutes: 49
- Size 4. Religious Activities: 368
- Size 5. Medical services: 600
- Size 6. Retail: shops/restaurants: 405
- Size 7. Sports clubs: 170
- Size 8. Garda stations: 60
- Size Total: 1,900

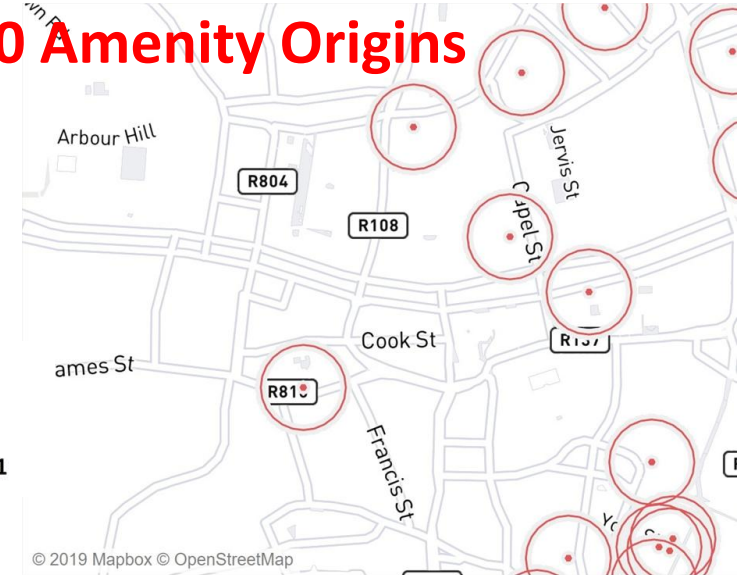
➤ **Names**

➤ **Coordinates**

➤ **Commercial-Delivery-Points**



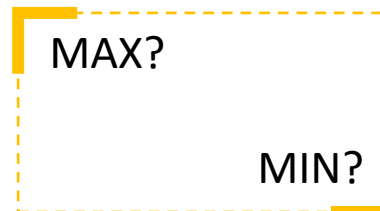
1900 Amenity Origins



* **KML** dataset.

- Size 1. All coordinates available in Dublin: 246,617

➤ **Coordinates**



1000 Random Destinations



* Dublin House Prices 2017 dataset from Daft (www.daft.ie)

- Size Total: 5362

- Price
- Coordinates
- Type of Dwelling (New/Second Hand)

AutoSave Off economic.csv - Excel Minkun Kim

FileHomeInsertPage LayoutFormulasDataReviewViewHelpSearch

ClipboardFontAlignmentNumberStylesCellsEditingIdeas

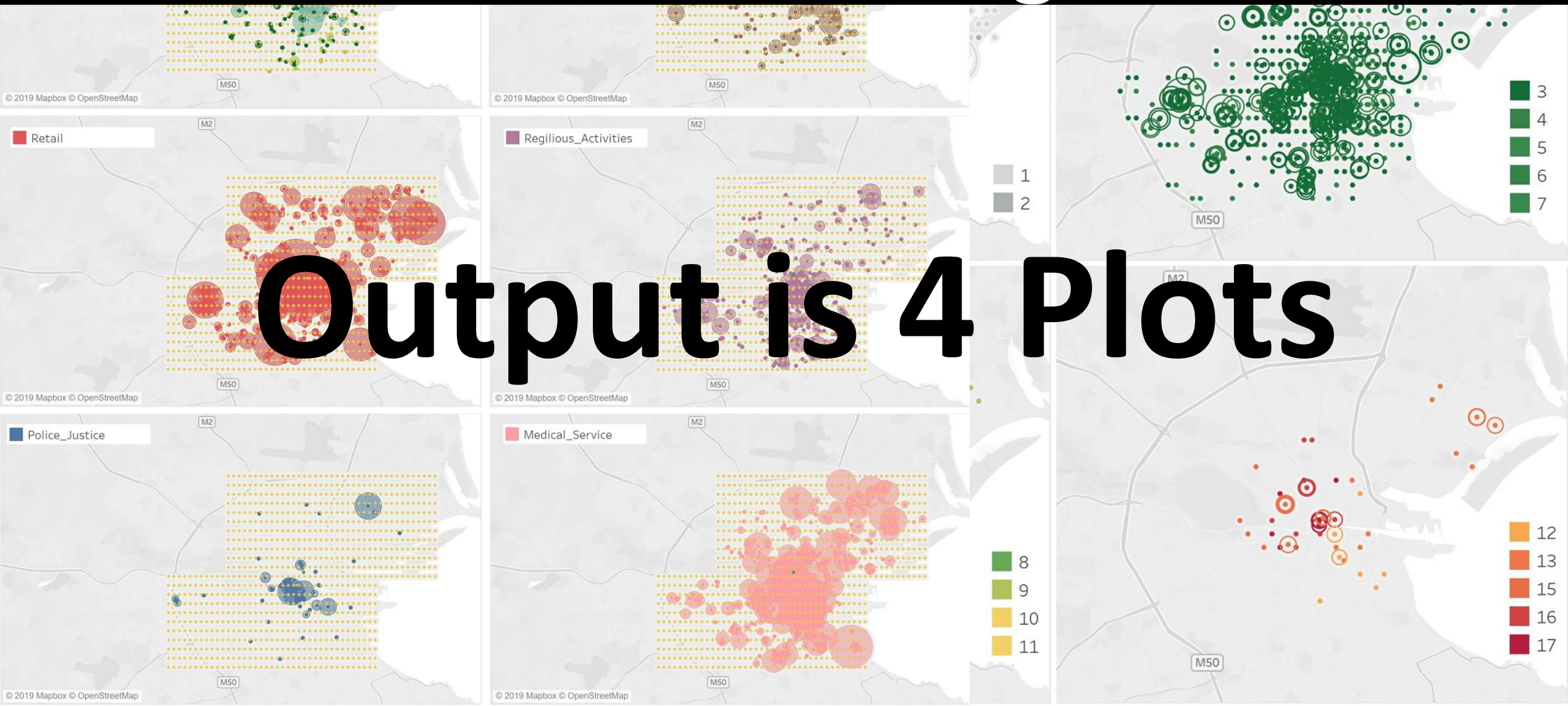
Conditional FormattingFormat as TableCell StylesInsertDeleteFormatSort & FilterFind & SelectIdeas

P1longitude

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S		
1	year	input_str	sale_date	address	postal_code	ppr	county	price	not_full	mvat	exclusi	description	property_s	date	formatted	accuracy	latitude	longitude	postcode	type	g
60918	2017	0,0,Dublin	#####	0,0	Dublin 15	Dublin		445475	No	Yes		New Dwell less than 3	#####	Calmount I	ROOFTOP		53.31296	-6.3458		car_dealer	S
60919	2017	1 ALEXANC	#####	1 ALEXANC	Dublin 2	Dublin		7750000	No	No		Second-Hand Dwelling	#####	Alexander	ROOFTOP		53.33487	-6.25438		premise	D
60920	2017	1 ARCADIA	#####	1 ARCADIA COURT, TH	Dublin			180000	No	No		Second-Hand Dwelling	#####	Arcadia Co	ROOFTOP		53.58056	-6.11151		premise	F
60921	2017	1 Abbot Co	#####	1 Abbot Court	Cualan	Dublin		242775.4	No	Yes		New Dwell greater tha	#####	33 Glenage	ROOFTOP		53.28276	-6.14111		establishm	D
60922	2017	1 Abbot's C	#####	1 Abbot's Grove	Avent	Dublin		343612.3	No	Yes		New Dwell greater tha	#####	24 Abbots	ROOFTOP		53.27106	-6.32524		establishm	S
60923	2017	1 Ashfield	#####	1 Ashfield Avenue,	Rid	Dublin		339207.1	No	Yes		New Dwell greater tha	#####	Miltonsfiel	GEOMETRI		53.45435	-6.22444		bus_statio	F
60924	2017	1 BARNAC	#####	1 BARNACOILLE PARK,	Dublin			1325000	No	No		Second-Hand Dwelling	#####	1 Barnacoi	RANGE_IN		53.28118	-6.10437		street_add	D
60925	2017	1 BEAUFIE	#####	1 BEAUFIELD PARK, ST	Dublin			520000	No	No		Second-Hand Dwelling	#####	1 Beaufield	ROOFTOP		53.28841	-6.20234	A94 N594	street_add	D
60926	2017	1 BELFRY P	#####	1 BELFRY PLACE, LUSK	Dublin			2.00E+05	No	No		Second-Hand Dwelling	#####	1 Belfry Pl,	ROOFTOP		53.52906	-6.16314	K45 E820	street_add	F
60927	2017	1 BELMON	#####	1 BELMON	Dublin 4	Dublin		660000	No	No		Second-Hand Dwelling	#####	1 Belmont	ROOFTOP		53.3224	-6.23842	D04 P8E2	street_add	D
60928	2017	1 BOLBRO	#####	1 BOLBRO	Dublin 24	Dublin		239000	No	No		Second-Hand Dwelling	#####	1 Bolbrook	ROOFTOP		53.28674	-6.34199	D24 Y9NN	street_add	S
60929	2017	1 BOYNE H	#####	1 BOYNE H	Dublin 1	Dublin		280000	No	No		Second-Hand Dwelling	#####	3 Boyne Hc	ROOFTOP		53.34935	-6.24261		subpremise	D
60930	2017	1 BROOKM	#####	1 BROOKM	Dublin 24	Dublin		240000	No	No		Second-Hand Dwelling	#####	1 Brookmc	ROOFTOP		53.29073	-6.33465	D24 W01T	street_add	S
60931	2017	1 BUTTERF	#####	1 BUTTERF	Dublin 14	Dublin		751000	No	No		Second-Hand Dwelling	#####	Butterfield	ROOFTOP		53.29577	-6.29143		premise	S
60932	2017	1 Balgriffin	#####	1 Balgriffin	Dublin 13	Dublin		3.00E+05	Yes	Yes		New Dwell greater tha	#####	1 Balgriffin	ROOFTOP		53.41076	-6.1644	D13 E3H7	street_add	F
60933	2017	1 Beresfor	#####	1 Beresford Place,	Dor	Dublin		308370	No	Yes		New Dwell greater tha	#####	1 Beresford	GEOMETRI		53.48891	-6.16244		establishm	F
60934	2017	1 Brock Ha	#####	1 Brock Hall, Brock's	Lz	Dublin		123348	No	Yes		New Dwell less than 3	#####	Apartment	ROOFTOP		53.29435	-6.14208		premise	D
60935	2017	1 CARNEW	#####	1 CARNEW	Dublin 7	Dublin		385000	No	No		Second-Hand Dwelling	#####	1 Carnew	ROOFTOP		53.35394	-6.29104	D07 T6N9	street_add	D
60936	2017	1 CARRAIG	#####	1 CARRAIG GRENNAN	Dublin			905000	No	No		Second-Hand Dwelling	#####	Carraig Gre	ROOFTOP		53.2582	-6.12399		premise	D
60937	2017	1 CASINO F	#####	1 CASINO F	Dublin 3	Dublin		395000	No	No		Second-Hand Dwelling	#####	1 Casino R	ROOFTOP		53.36873	-6.23295	D03 F2H6	street_add	D

economic

3. Visualization + Insight



Google Map Walkability =

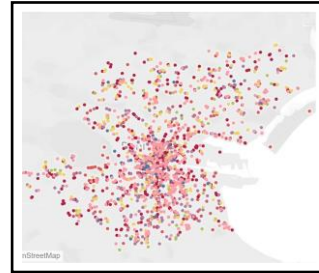


-



Step 1

Pre-processing
1000 Random
Destinations;
Data: KML file
Tool: Python Lib
"Beautifulsoup4",
"Numpy", "Pandas"



Step 2

Pre-processing
1,900 Amenity
Origins;
Data: NACE Code
Tool: Python Lib
"Numpy", "Pandas"



Step 3

Computing
straight lines with
Euclidean
distance;
Tool: "math",
"Numpy", "Pandas"



Step 4

Computing
footpaths with
Google Map API;
Tool: Python Lib
"json", "urllib",
"googlemap"



Step 5

**Feeding
data** into
Tableau;

STEP-3/4/5

> Euclidean Calculation using Haversine formula;
> 4,863 calculations in total.

API request output in Json;
The first part of the 'legs' gives summary information, and 'steps' gives each individual information on waypoints that constitute the travel path.

5. Plotting footpaths in Tableau

	Route_label	Point_ID	S_lat	S_lon	weight	label	travel
0	1	1	53.333572	-6.254355	3	Regilious_Activities	2.6
1	1	2	53.336147	-6.257284	3	Regilious_Activities	2.6
2	1	3	53.336287	-6.257182	3	Regilious_Activities	2.6
3	1	4	53.336385	-6.257331	3	Regilious_Activities	2.6
4	1	5	53.336364	-6.257405	3	Regilious_Activities	2.6
5	1	6	53.337494	-6.258753	3	Regilious_Activities	2.6

3.

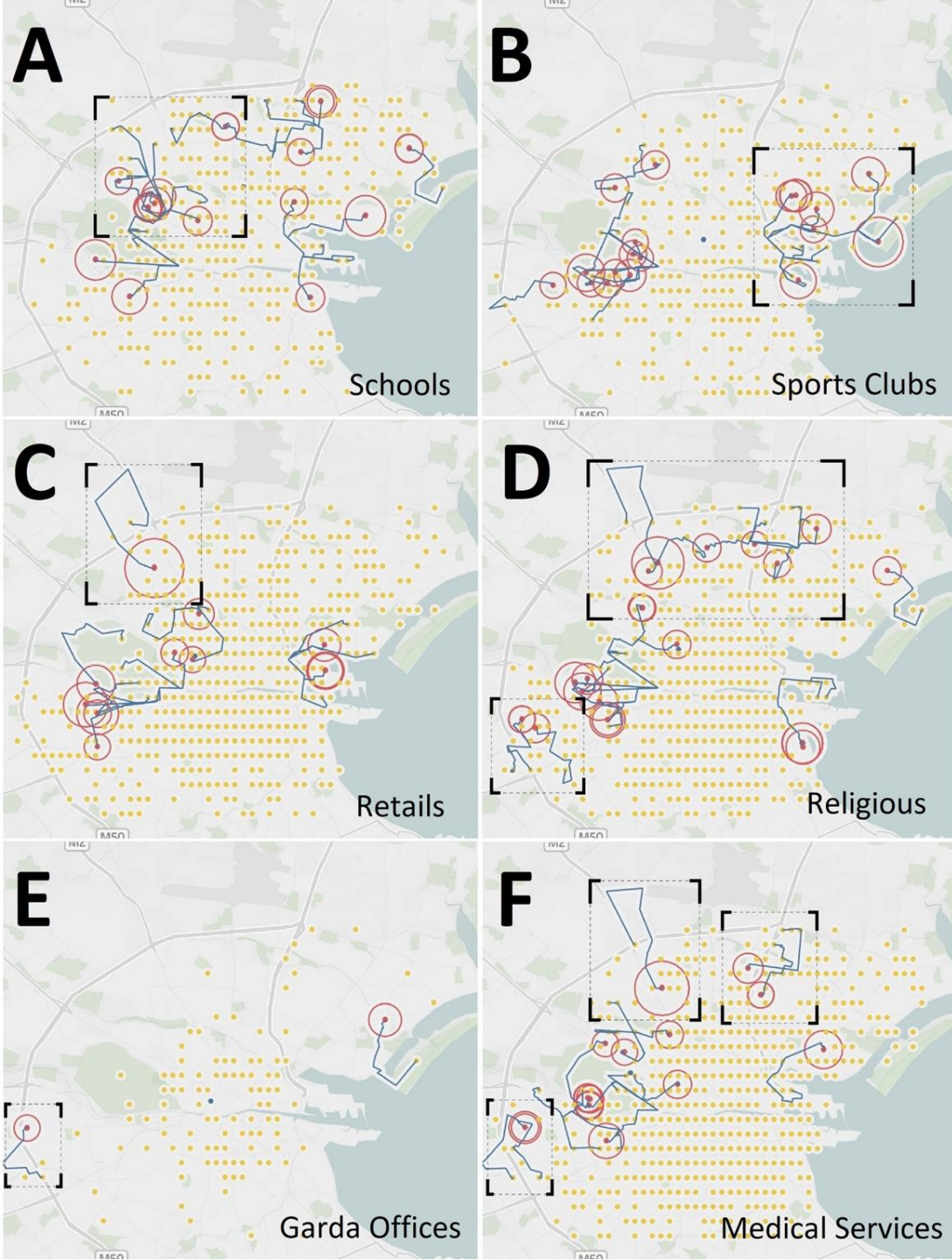
	g_lat	g_lon	g_label	E_lat	E_lon	E_label	E_Name	weight	label	EUC_dist
4858	53.330	-6.300	g_280	53.347937	-6.300695	E_1897	HSE CLINIC	5	Medical_Service	1.995707
4859	53.335	-6.280	g_369	53.347937	-6.300695	E_1897	HSE CLINIC	5	Medical_Service	1.989894
4860	53.330	-6.255	g_478	53.345223	-6.239029	E_1898	HANOVER MEDICAL CENTRE	2	Medical_Service	1.998010
4861	53.350	-6.210	g_680	53.345223	-6.239029	E_1898	HANOVER MEDICAL CENTRE	2	Medical_Service	1.999423
4862	53.340	-6.280	g_370	53.341145	-6.250171	E_1899	MERRION SQUARE OSTEOPATHS	5	Medical_Service	1.985075

4.1

```
{
  'legs': [
    {
      'distance': {
        'text': '2.4 km',
        'value': 2383,
      },
      'duration': {
        'text': '30 mins',
        'value': 1817,
      },
      'end_address': '34 Clanbrassil Street Upper, Wood Quay, Dublin 8, D08 FY00, Ireland',
      'end_location': {
        'lat': 53.3298152,
        'lng': -6.2750163,
      },
      'start_address': 'Apartment 2, O'Connell House, 58 Merrion Square S, Dublin 2, D02 X571, Ireland',
      'start_location': {
        'lat': 53.3385232,
        'lng': -6.2485123,
      },
      'steps': [
        {
          'distance': {
            'text': '61 m',
            'value': 61,
          },
          'duration': {
            'text': '1 min',
            'value': 43,
          },
          'end_location': {
            'lat': 53.3382419,
            'lng': -6.247722700000001,
          },
          'html_instructions': 'Head <b>southeast</b> on <b>Merrion Square S</b> toward <b>Cearnóg Mhuirfean Thoir</b>',
          'polyline': {
            'points': 'wtpdIdlce@v@C',
          },
          'start_location': {
            'lat': 53.3385232,
            'lng': -6.2485123,
          },
          'travel_mode': 'WALKING',
        },
        {
          'distance': {
            'text': '0.2 km',
            'value': 227,
          },
          'duration': {
            'text': '3 mins',
            'value': 168,
          },
          'end_location': {
            'lat': 53.3298152,
            'lng': -6.2750163,
          },
          'html_instructions': 'Continue onto <b>Windsor Terrace</b><div style="font-size:0.9em">Destination will be on the right</div>',
          'polyline': {
            'points': 'e~ndInlge@BzA@AA1FCbCA@CxB',
          },
          'start_location': {
            'lat': 53.3297947,
            'lng': -6.2716049,
          },
          'travel_mode': 'WALKING',
        },
      ],
      'traffic_speed_entry': [],
      'via_waypoint': [],
    },
  ],
  'overview_polyline': {
    'points': 'wtpdIdlce@v@Cn@r@nBrBfAz@z@z@fB1BjDhDpAfAhEfEpEvEx@l@JJ' AkAHGRN@FPnATxBjAJJr@vEHJA?NAJGDNP@^|CLjAR~BRrAZrAFKH^RrAft@LbIN1HFxA?ZOXP|AD^@dAJxE@TMNBPTzGFx@d@xQ?nHEdCxB',
  },
  'summary': 'Portobello Rd',
  'warnings': ['Walking directions are in beta. Use caution - This route may be missing sidewalks or pedestrian paths.'],
  'waypoint_order': []
}
```

4.2

	g_lat	g_lon	g_label	E_lat	E_lon	E_label	E_Name	weight	label	EUC_dist	travel	steps	discrepancy
4769	53.355	-6.240	g_549	53.352130	-6.269437	E_998	HENRIETTA HALL	2	Retail	1.980229	2.5	['1', '53.3522535', '-6.2693262', '2', '53.352...	0.519771
4770	53.370	-6.270	g_420	53.352130	-6.269437	E_998	HENRIETTA HALL	2	Retail	1.988020	2.3	['1', '53.3522535', '-6.2693262', '2', '53.352...	0.311980
4771	53.335	-6.285	g_347	53.350681	-6.271074	E_999	EUROPEAN MARKET	1	Retail	1.974191	2.6	['1', '53.3506906', '-6.2709093', '2', '53.350...	0.625809
4772	53.355	-6.300	g_285	53.350681	-6.271074	E_999	EUROPEAN MARKET	1	Retail	1.979593	2.6	['1', '53.3506906', '-6.2709093', '2', '53.350...	0.620407
4773	53.340	-6.295	g_304	53.350681	-6.271074	E_999	EUROPEAN MARKET	1	Retail	1.983827	2.6	['1', '53.3506906', '-6.2709093', '2', '53.350...	0.616173

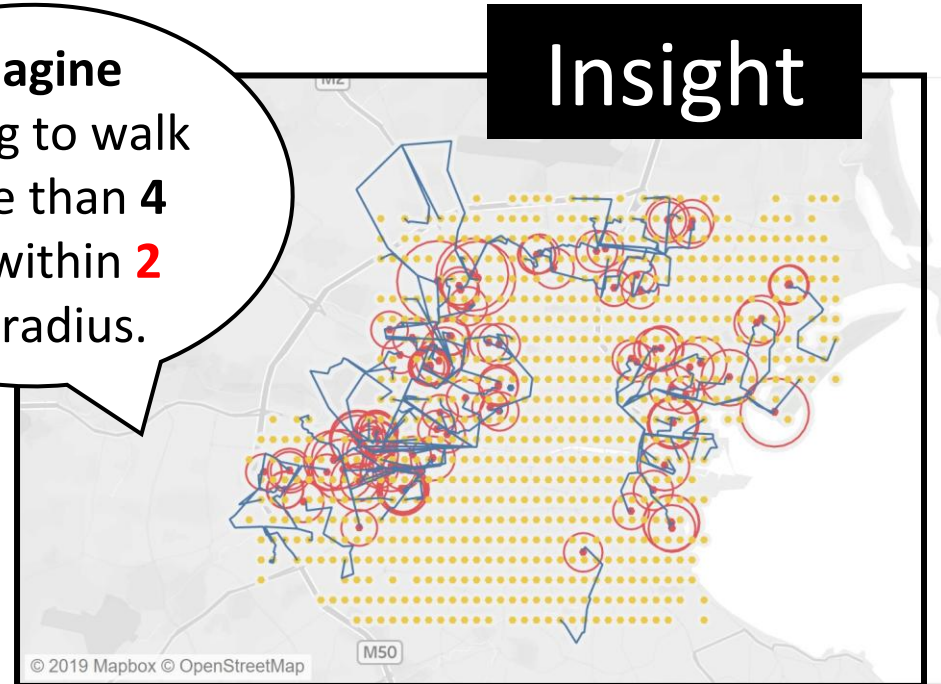


Plot 01. Less walkable Areas with Articulation of the Footpaths

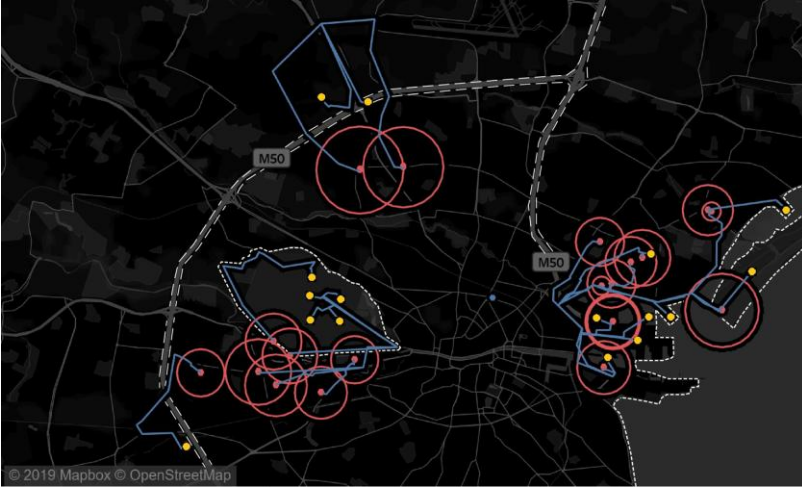
Using **Circle size** referring to the difference in the travel lengths calculated by Euclidean and Google Map's algorithms.

Imagine
having to walk
more than 4
km within **2**
km radius.

Insight

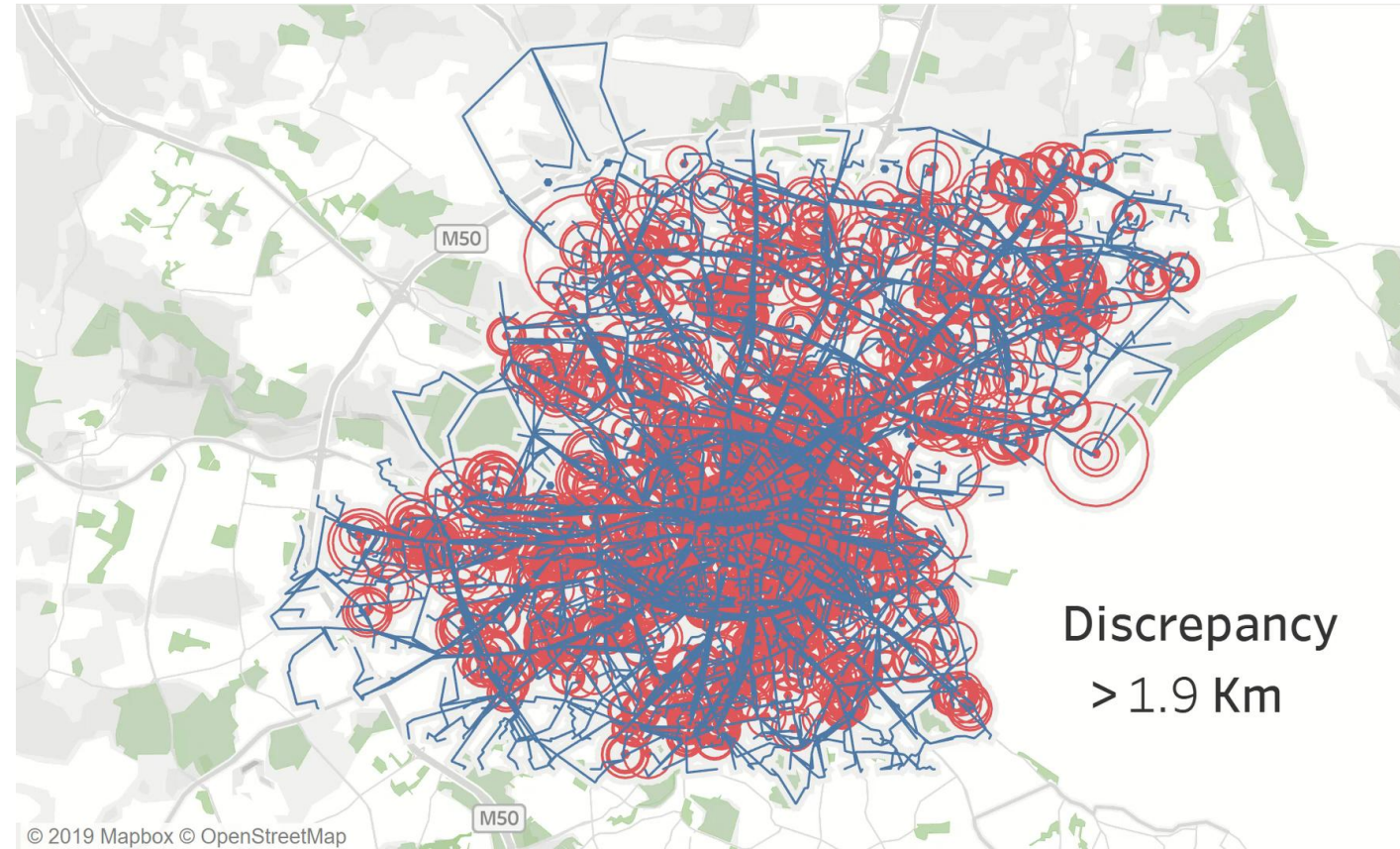


Insight

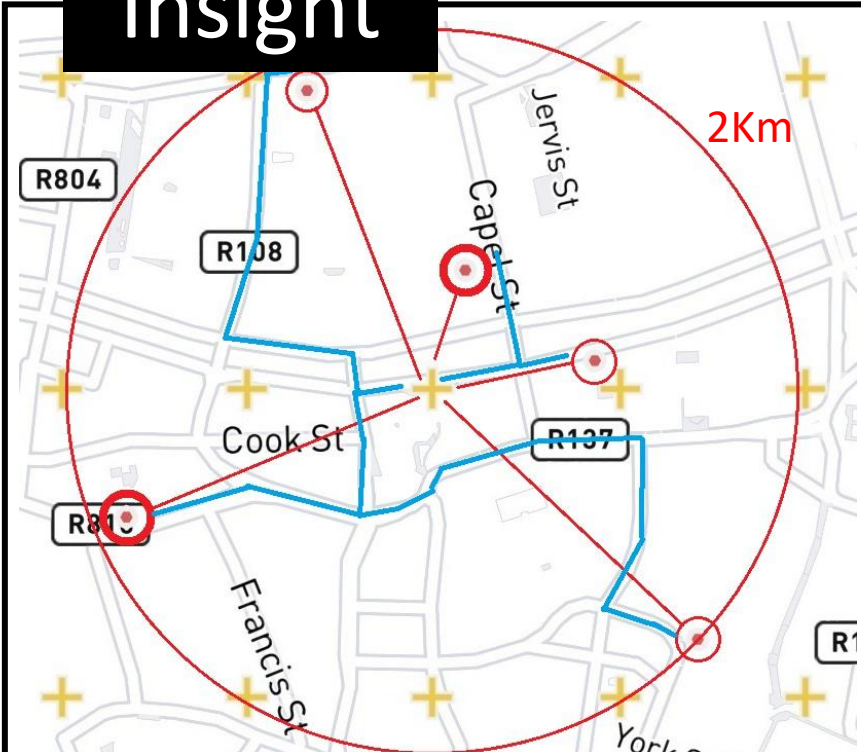


Top 20 Unwalkable areas - **Ballyfermot, Finglas, Marino, etc.** This results from poorly designed relationships between urban infrastructure and inner suburbs – **Loosely Defined Urbanity!**

What's going on ?



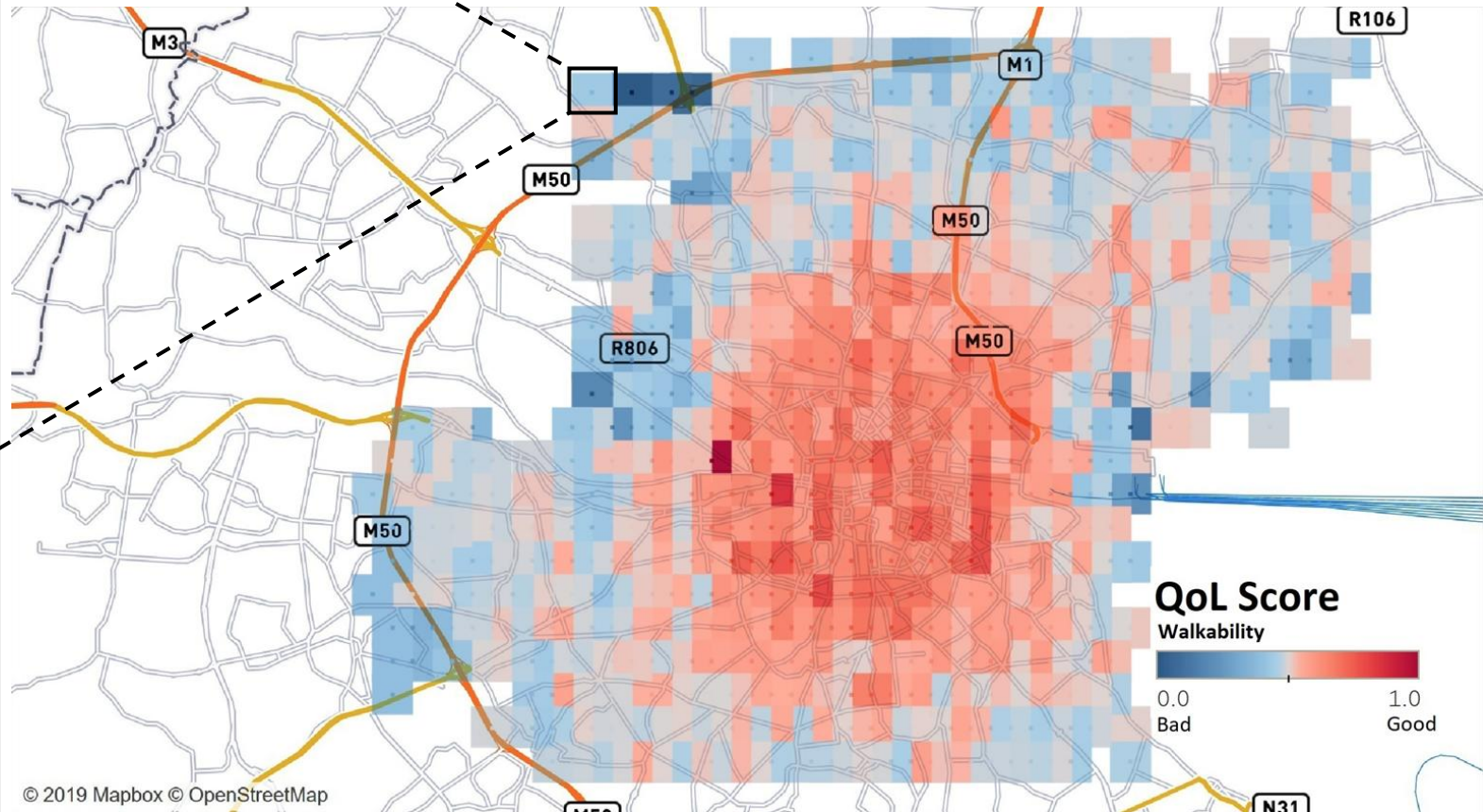
Insight



Q. Does this area have a good QoL?
> How many amenity facilities captured?
> Walkable?

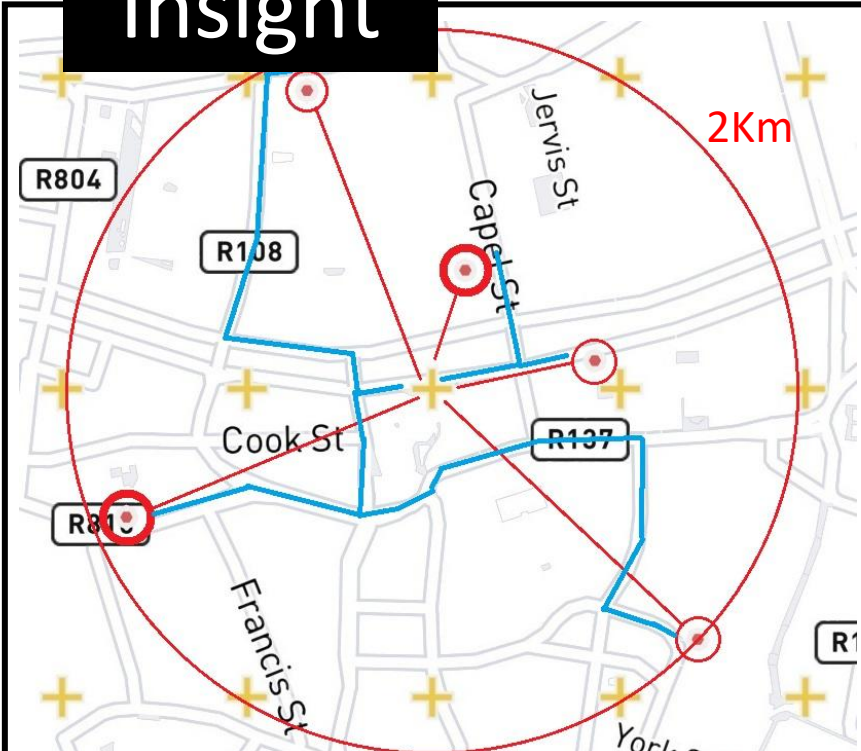
Plot 02. New QoL Scoring Map

QoL: Walkability



© 2019 Mapbox © OpenStreetMap

Insight



Q. Does this area have a good QoL?

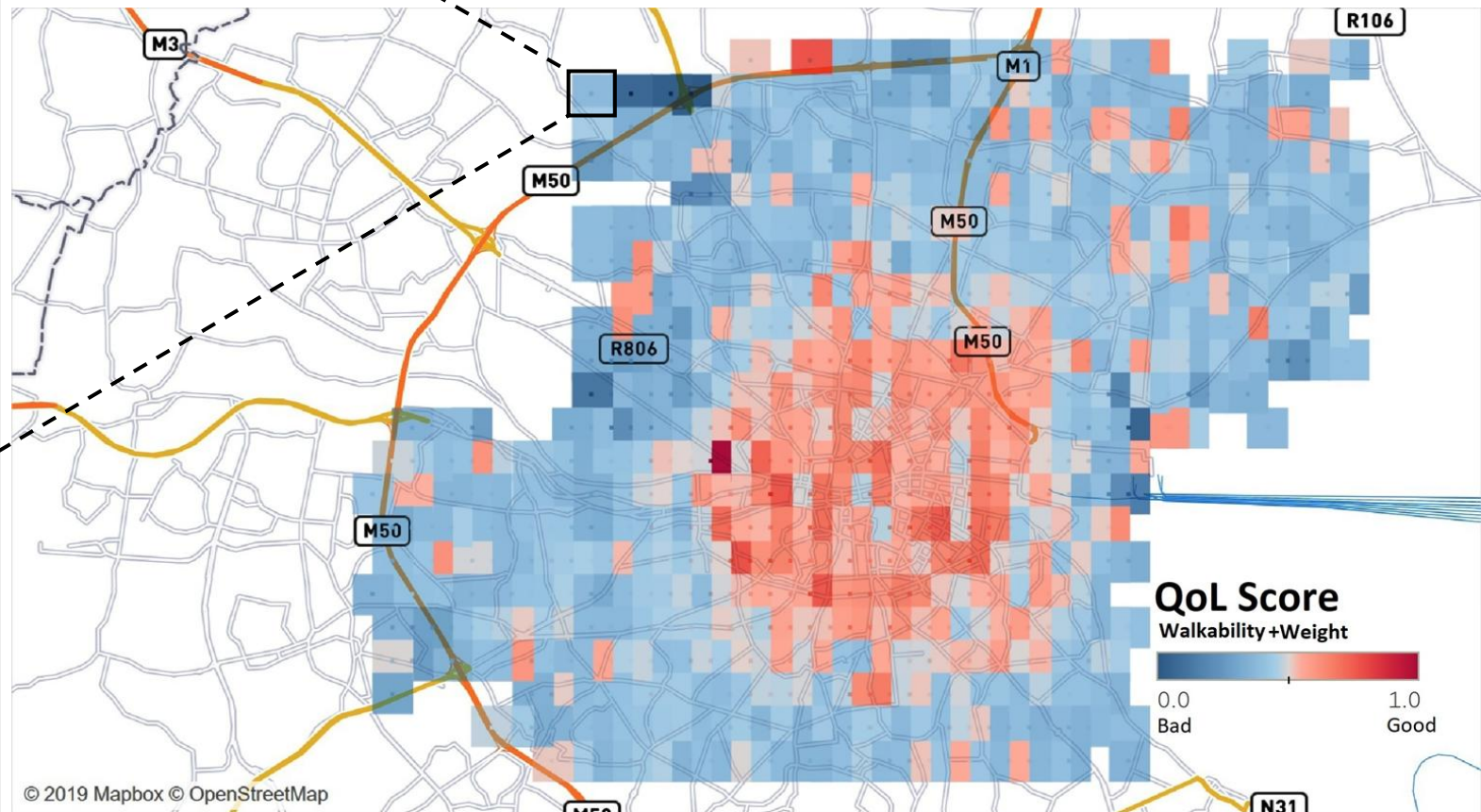
> How many amenity facilities captured?

> Walkable?

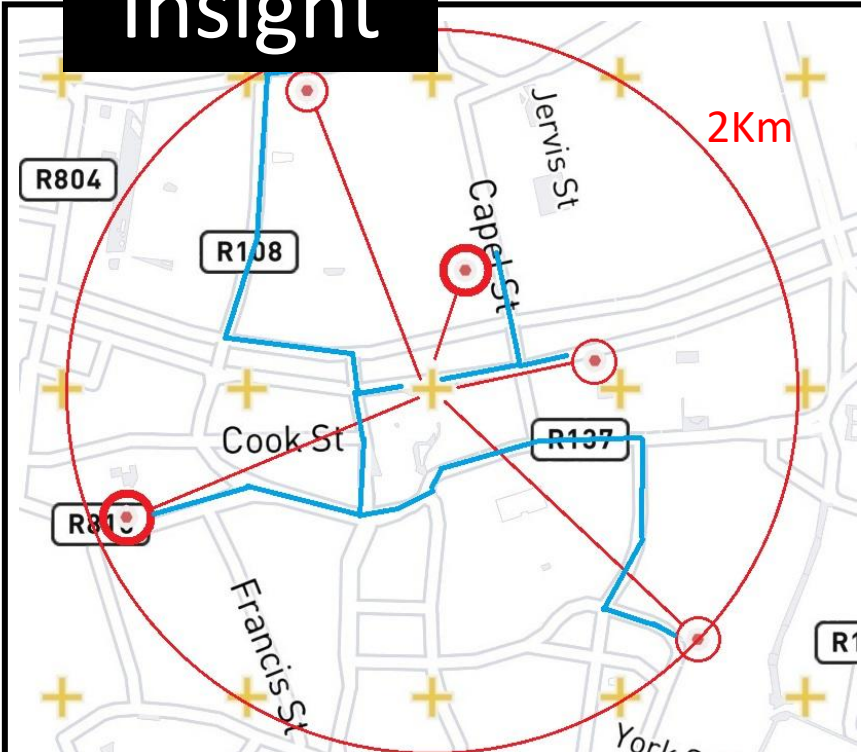
> **More people (activities)?**

Plot 03. New QoL Scoring Map

QoL: Walkability + Importance weight



Insight



Q. Does this area have a good QoL?

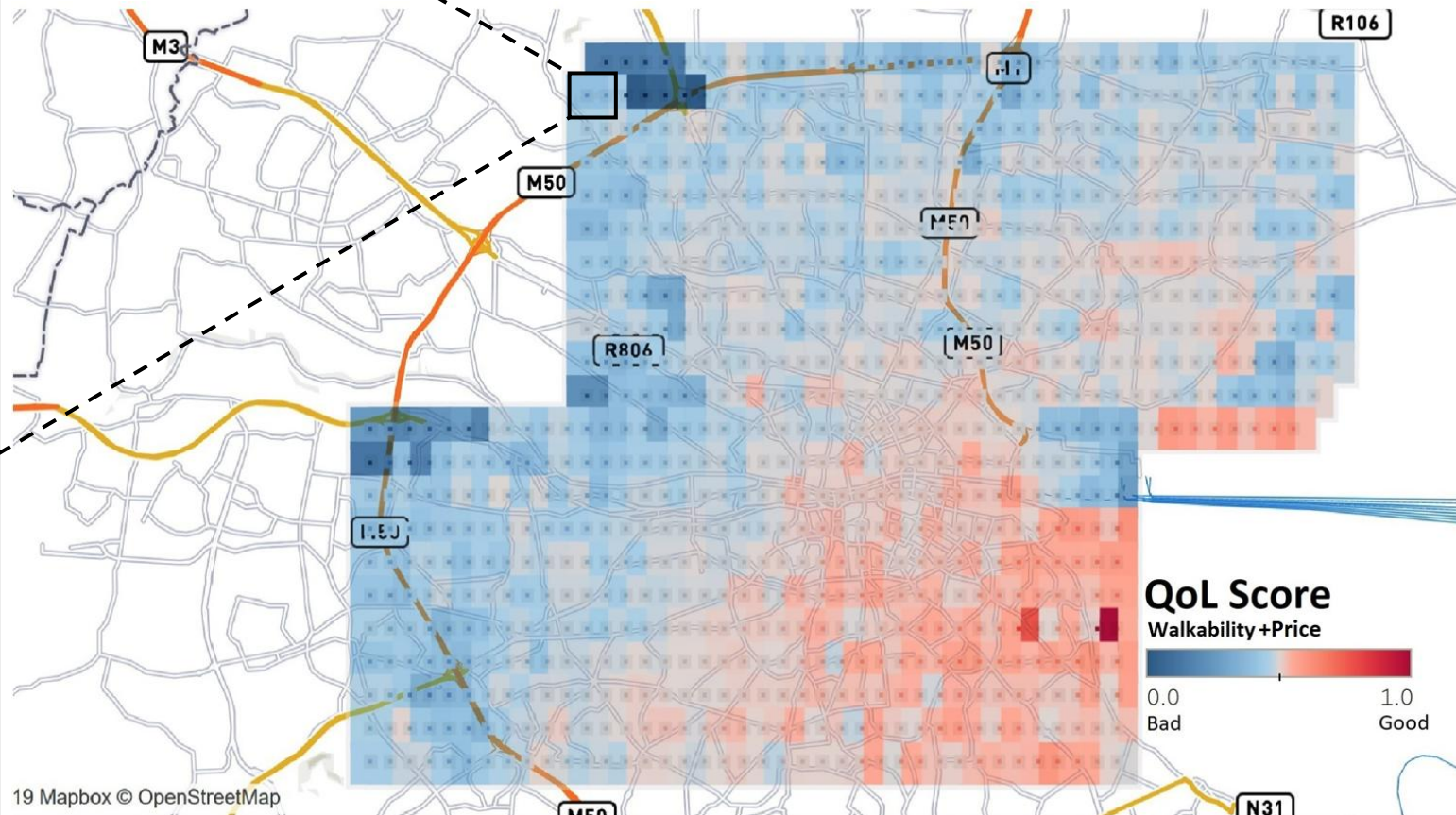
> How many houses captured?

> Walkable?

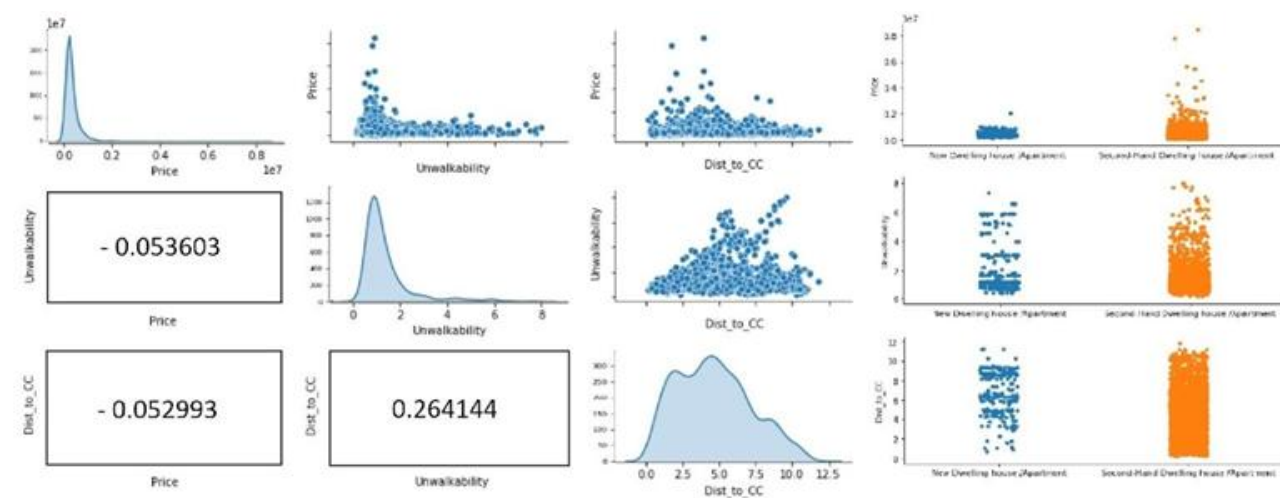
> **More Profit from housing?**

Plot 04. New QoL Scoring Map

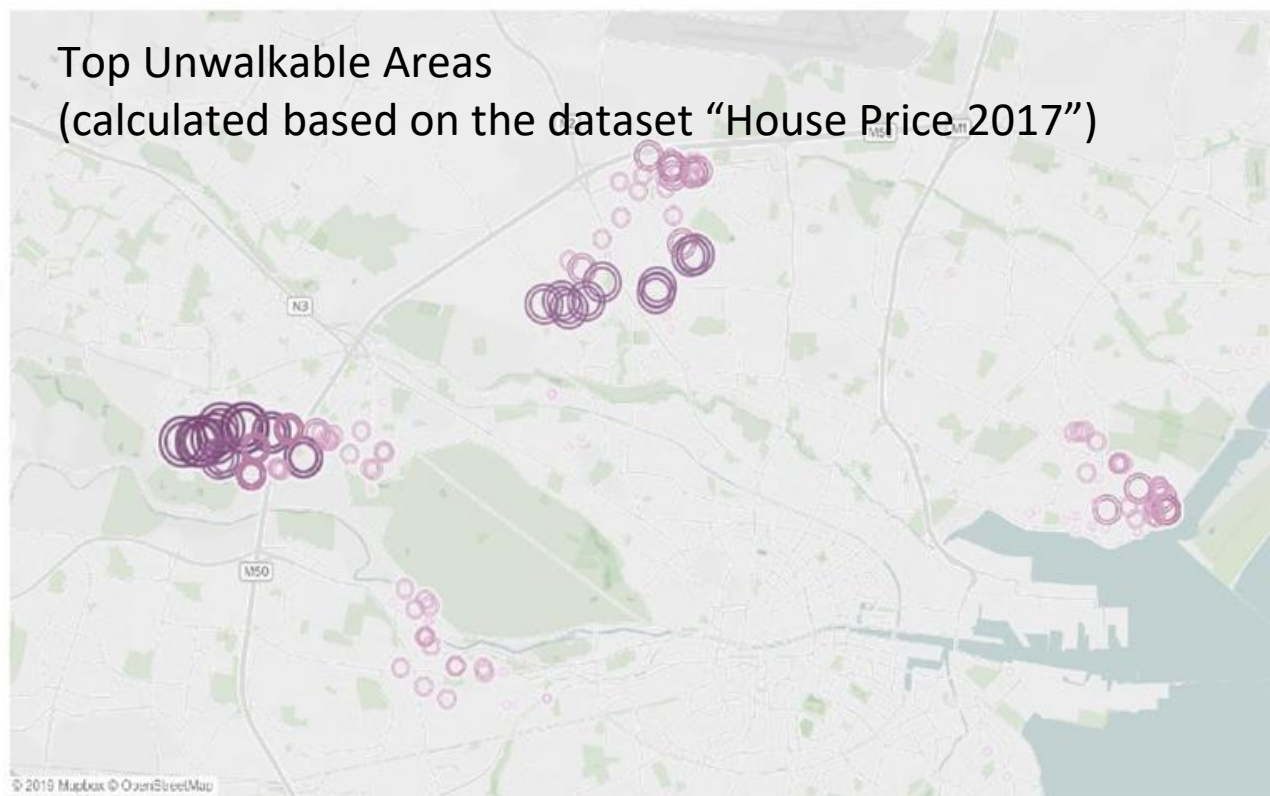
QoL: Walkability + House Price



4. Quantification + Insight

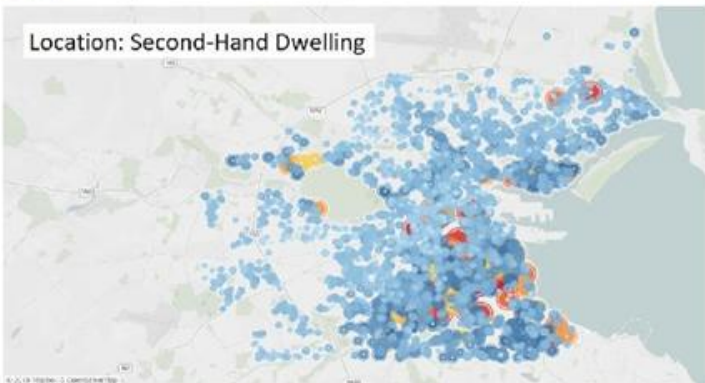
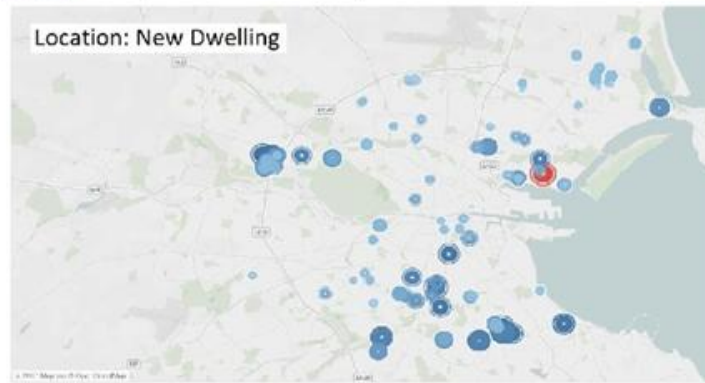
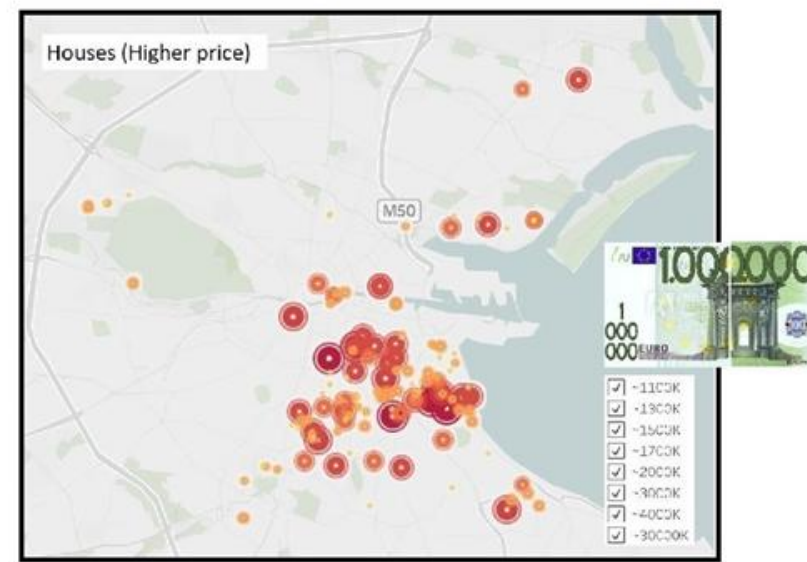
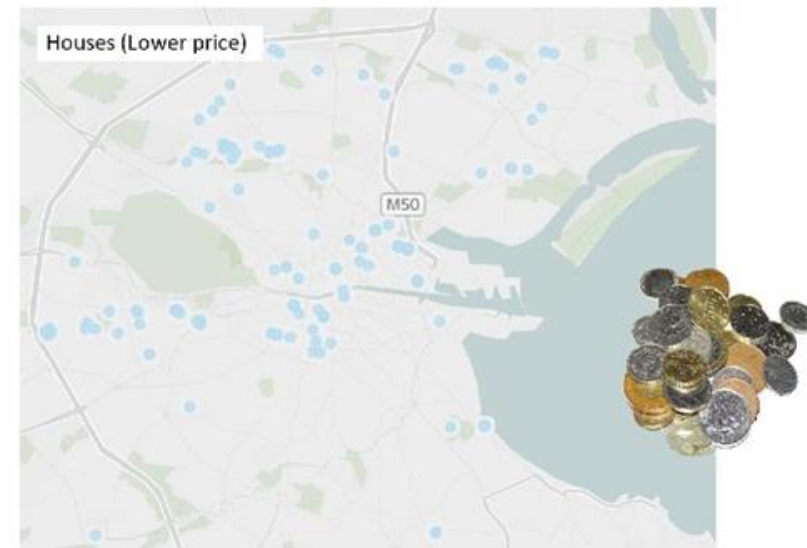
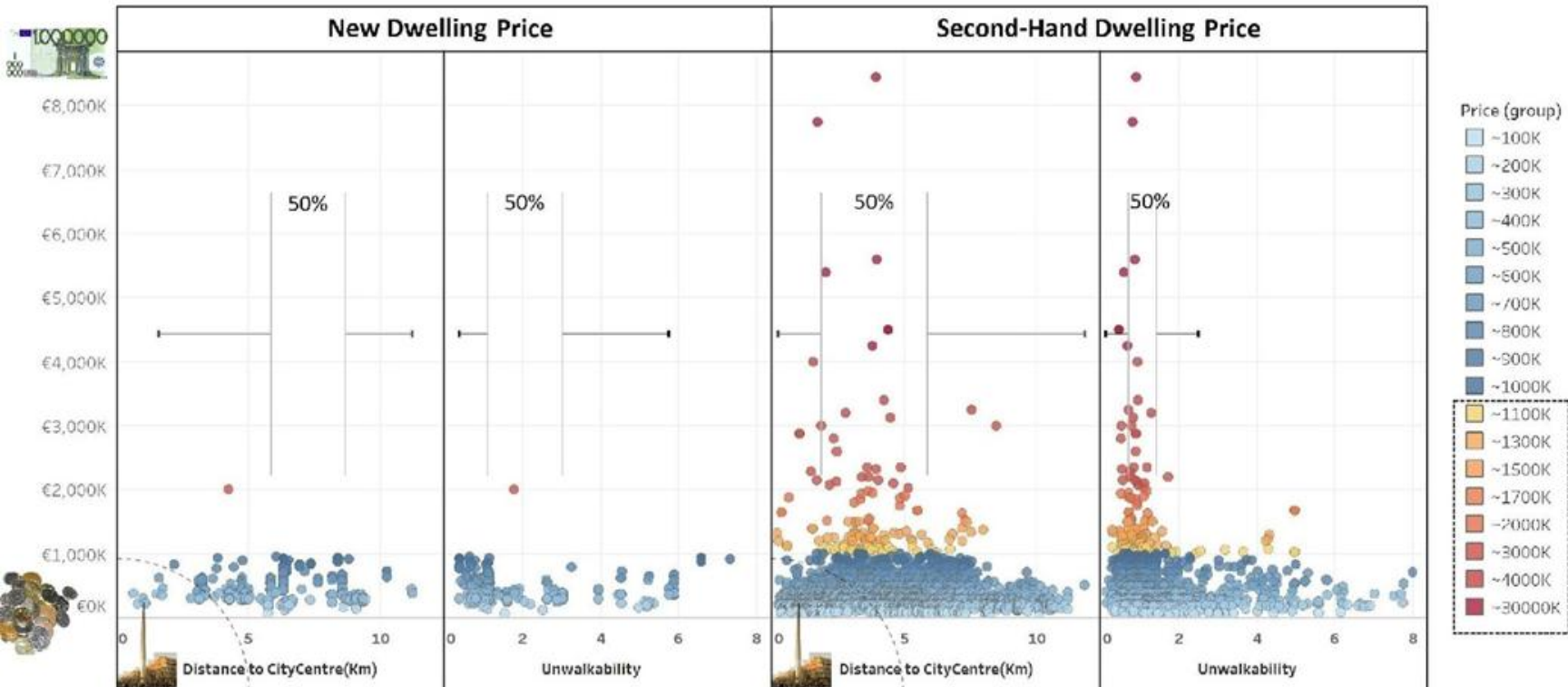


	E_lat	E_lon	Type	Price	Unwalkability	Dist_to_CC
5357	53.298310	-6.194897	Second-Hand Dwelling house /Apartment	290000.0	1.025890	7.193800
5358	53.309336	-6.206780	Second-Hand Dwelling house /Apartment	790000.0	0.921666	5.740201
5359	53.293223	-6.267921	New Dwelling house /Apartment	563876.0	1.132709	6.325055
5360	53.384218	-6.275218	Second-Hand Dwelling house /Apartment	295000.0	0.761570	1.878872
5361	53.360500	-6.263439	Second-Hand Dwelling house /Apartment	150000.0	1.348216	1.198439
Second-Hand Dwelling house /Apartment			4314			
New Dwelling house /Apartment			1048			



: Any Relationship between **House Price** and below?

> Predictors Used: 1.Type(binary), 2.Distance_to_the_City_Centre(numeric), 3. Unwalkability(numeric)

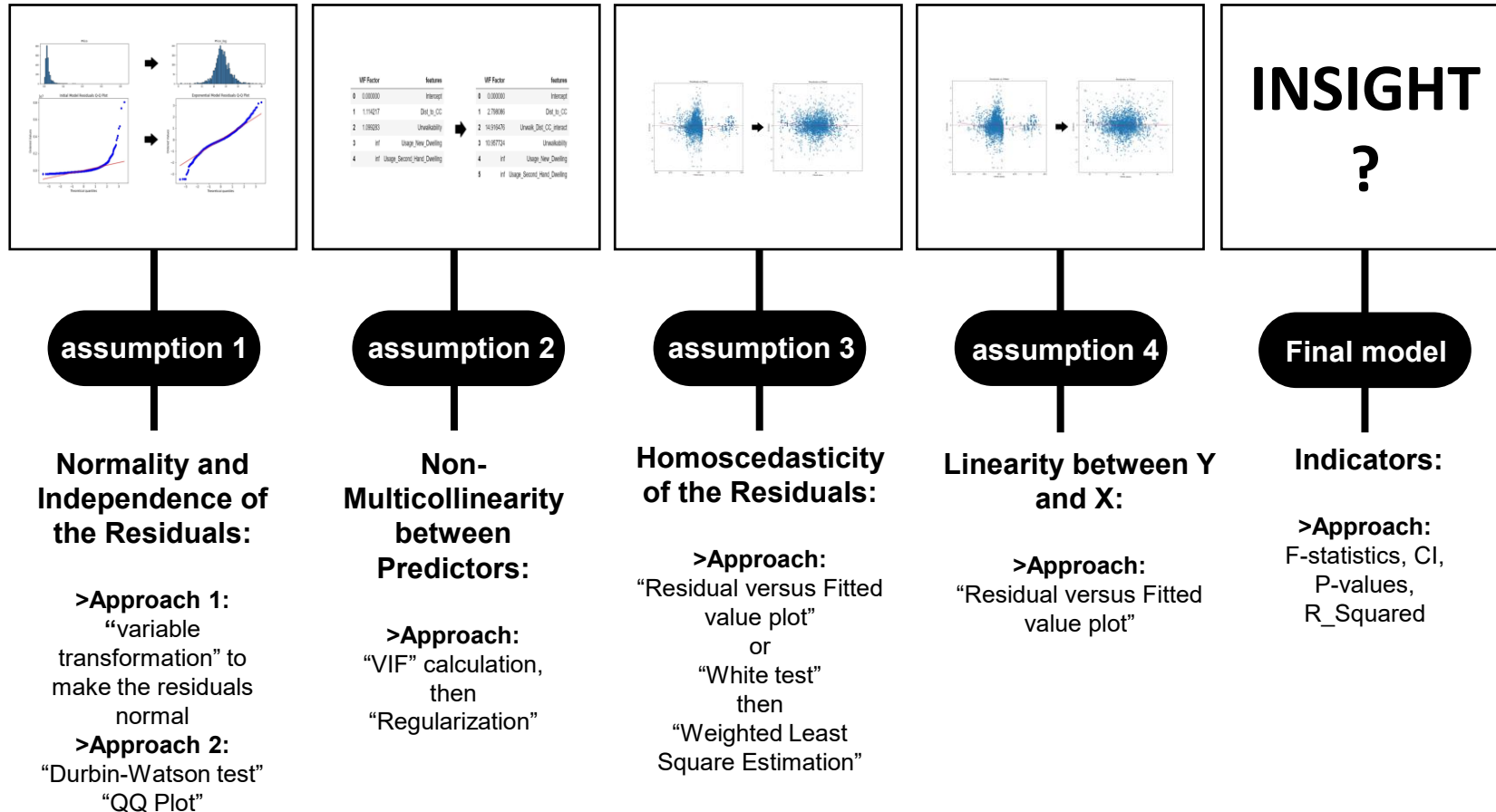


$$\text{HousePrice}_i = e^{\beta_0 + \beta_1 \mathbf{X}_{1i} + \beta_2 \mathbf{X}_{2i} + \beta_3 \mathbf{X}_{3i} + \beta_4 (\mathbf{X}_{2i} \mathbf{X}_{3i}) + \beta_5 (\mathbf{X}_{2i} \mathbf{X}_{1i}) + \epsilon_i}$$

where \mathbf{X}_1 is “Type”, \mathbf{X}_2 is “Unwalkability”, \mathbf{X}_3 is “Distance-to-CC” and $\mathbf{X}_2 \mathbf{X}_3$ is the interaction between “Unwalkability” and “Distance-to-CC”, and $\mathbf{X}_2 \mathbf{X}_1$ is the interaction between “Unwalkability” and “Type”.

Regression Process:

[Aim]: Not Prediction but **Understanding the relationships**



5. Conclusion

A. Vis 01:

The unwalkable areas are likely to appear around the urban edge of Dublin City

B. Vis 02/03/04:

- The 3 Maps tell us the QoL in the unwalkable areas can get worse due to lack of social activities (small importance weights).
- House Prices were not definitive and called for more research.

C. Relationships

$$\begin{aligned}\log(HousePrice_i) = & 15.67 + 0.54 * Type_i \\ & - 0.39 * Unwalkability_i \\ & - 0.34 * DistCityCentre_i \\ & + 7.34 * (Unwalkability_i * Type1_i) \\ & + 4.67 * (Unwalkability_i * Type0_i) \\ & - 3.37 * (Unwalkability_i * DistCityCentre_i)\end{aligned}$$